Chapter 6 – Nonpoint Sources

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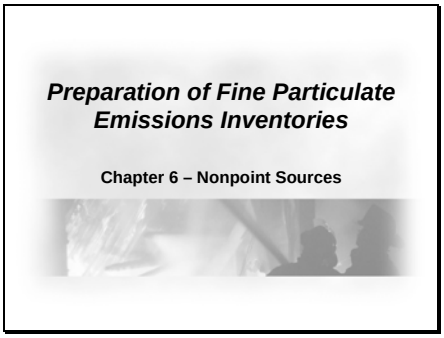

After completing this lesson, participants will be able to:

- describe the approach used to identify nonpoint sources for inclusion in an emissions inventory
- list the methodologies for estimating emissions from nonpoint sources
- reconcile fugitive emissions data with ambient data

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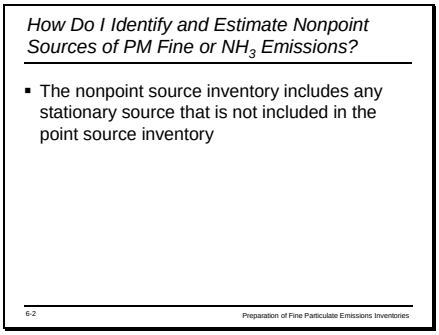

A nonpoint source refers to any stationary source that is not included in the point source inventory. For emission inventory development purposes, EPA has traditionally used the term "area sources" to refer to stationary air pollutant emission sources that are not inventoried at the facility-level.

The Consolidated Emissions Reporting Rule specifies reporting thresholds for point and area sources of criteria air pollutants. These will vary depending on the pollutant and the attainment status of the county in which the source is located.

The Clean Air Act defines area sources of Hazardous Air Pollutants for the purpose of identifying regulatory applicability.

The CAA defines an area HAP source as "any stationary source that emits or has the potential to emit considering controls, in the aggregate, less than 10 tons per year of any HAP or 25 tons per year of any combination of HAPs."

Sources that emit HAPs above these thresholds are categorized as "major sources."

To reduce confusion between these two sets of area source definitions, EPA has adopted the term "nonpoint" to refer to all criteria air pollutant and HAP stationary emission sources that are not incorporated into the point source component of the NEI.

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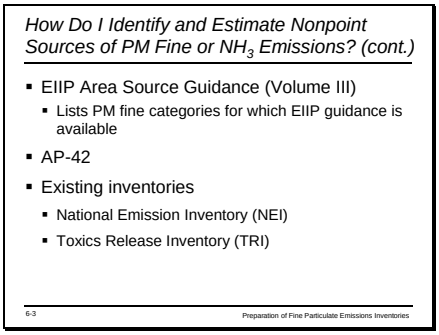

Volume III of the EIIP Area Source Guidance lists the PM fine categories for which the EIIP guidance is available.

AP-42 and existing emission inventories also can help identify nonpoint source categories that are sources of fine PM and ammonia emissions.

Existing inventories include:

- National Emissions Inventory
- Toxics Release Inventory
- inventories developed through regional planning organizations or state and local agencies.

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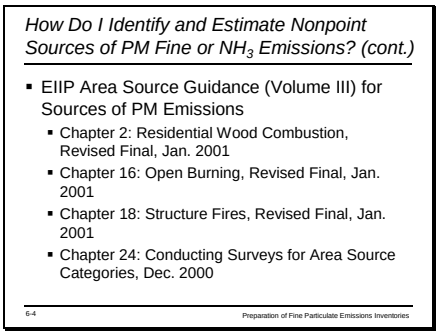

The chapters of Volume III of the EIIP Area Source Guidance that are useful for identifying nonpoint source categories of fine PM and ammonia are listed here.

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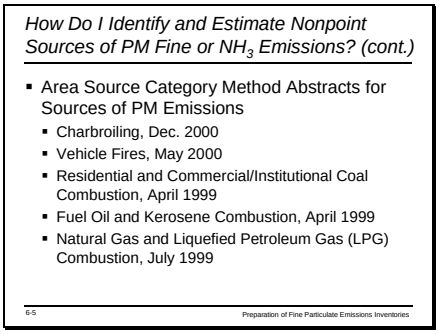

The EIIP also has "area source category method abstracts" for charbroiling, vehicle fires, residential and commercial/institutional coal combustion, fuel oil and kerosene combustion, and natural gas and liquefied petroleum gas combustion.

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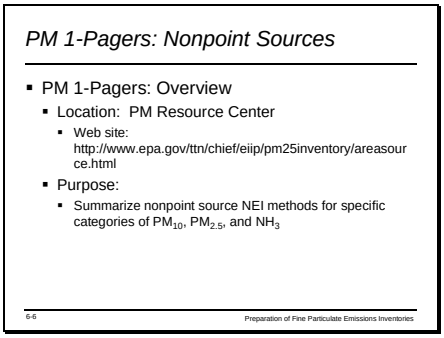

The PM2.5 Resource Center, which is available on the CHIEF website, contains "PM one-pagers."

These documents contain an overview of the NEI methods and summarize nonpoint source NEI methods for specific categories of PM_{10}, $PM_{2.5}$, and ammonia.

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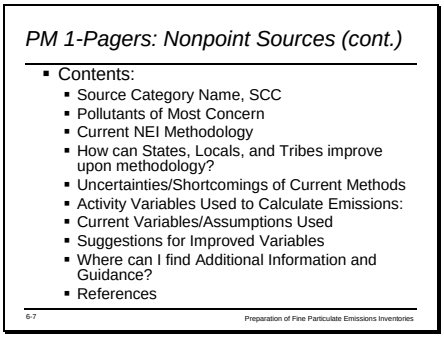

The PM one-pagers provides the source category name and SCC, the pollutants of most concern, current NEI method, and how state, locals, and tribal agencies can improve on the NEI method, uncertainties and shortcomings.

They also contain activity variables used to calculate the emissions, current variables and assumptions used in the methods, suggestions for improving the variables, and where to find additional information and guidance for the categories.

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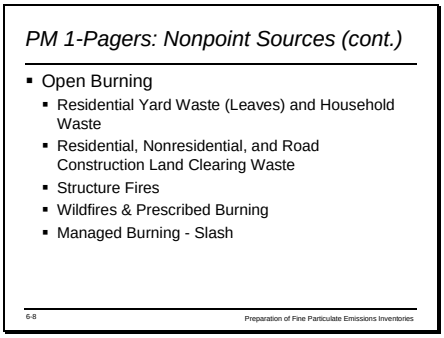

The open burning categories covered by the one-pagers include residential yard waste for leaves, household waste, residential, nonresidential, and road construction land clearing waste, structure fires, wildfires and prescribed burning, and managed or slash burning.

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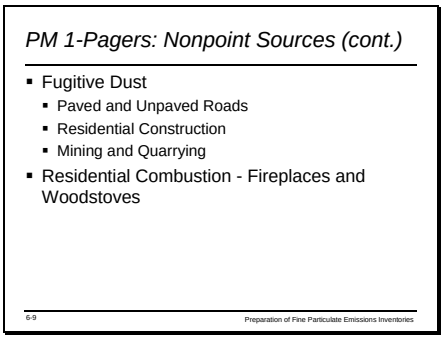

Fugitive dust categories covered by the one-pagers include paved and unpaved roads, residential construction, and mining and quarrying.

There are also one-pagers covering residential combustion (i.e., fireplaces, woodstoves, and other residential home heaters that burn natural gas or fuel oil).

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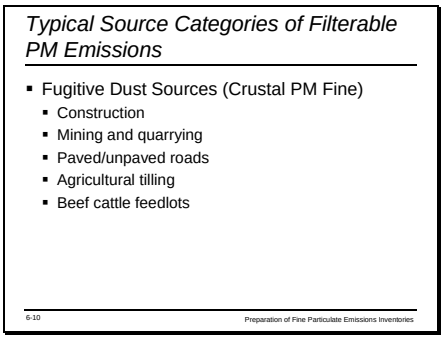

This list represents typical area source categories of fugitive dust sources of filterable PM emissions.

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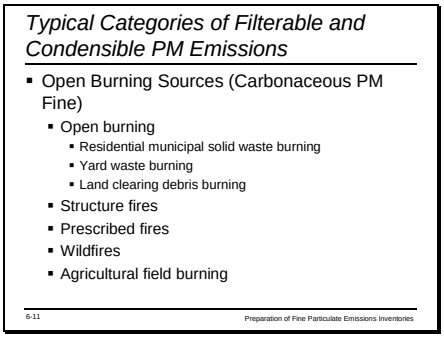

This list contains typical area source categories of open burning sources of filterable PM emissions.

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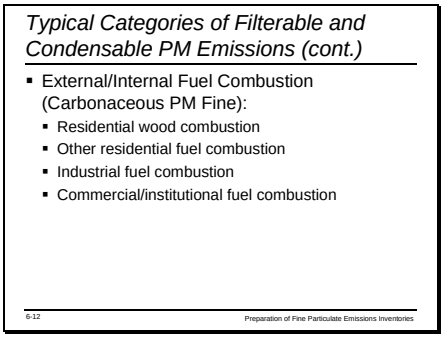

This list shows typical area source categories of filterable and condensable PM emissions.

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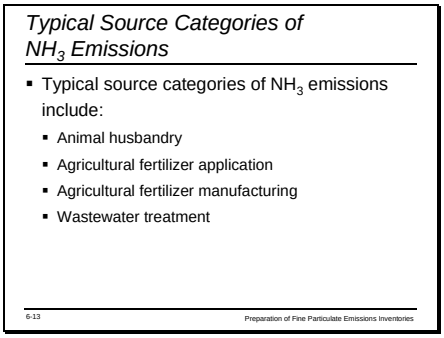

This list presents typical area source categories of ammonia sources.

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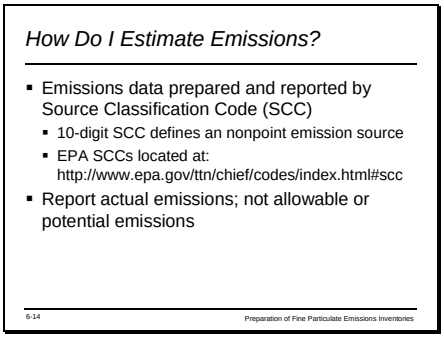

Nonpoint source inventories are prepared and reported by the 10-digit SCC source classification code.

EPA's master list of SCCs are available on the CHIEF website. This is a dynamic list that can be updated (with EPA's approval) to add SCCs.

For example, SCCs should be added if there are several subcategories within a general nonpoint source category and a state or local agency is estimating emissions at that level.

Also, actual emissions, not allowable or potential emissions are reported for the NEI.

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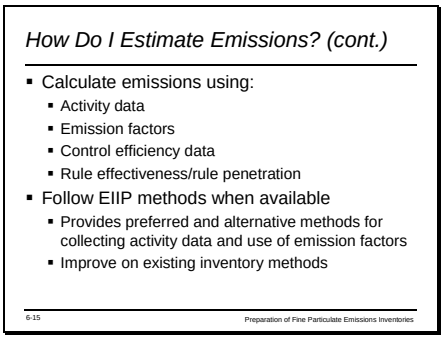

To calculate emissions from nonpoint sources, multiply the activity data by the emission factor, control efficiency data, rule effectiveness, and rule penetration.

EPA guidance specifically excludes applying default RE/RP assumption values for PM inventories.

You should follow EIIP methods, since these were developed with state and local input and they reflect the most current standardized procedures for preparing emission inventories.

The EIIP provides preferred and alternative methods for collecting activity data and the use of emission factors, and contains suggested improvements on existing inventory methods.

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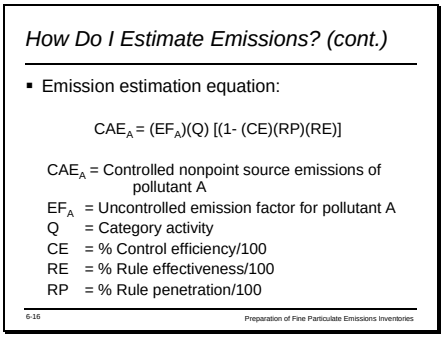

This equation is used to estimate emissions.

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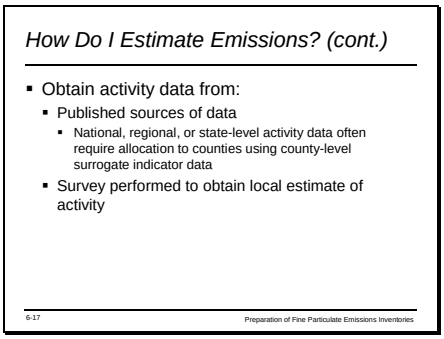

Activity data is obtained from various published sources of data or surveys. However, the use of use national, regional and state level activity data requires allocation to the counties using county-level surrogate indicator data.

Consequently, surveying is the preferred approach to obtain the local activity estimates(i.e., a bottom-up approach, rather than a top-down approach).

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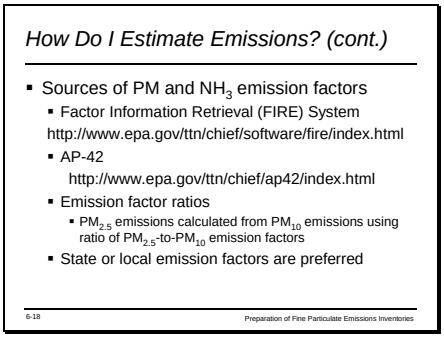

You can obtain emission factors for PM and ammonia from FIRE and AP-42.

As an alternative, you can use the emission factor ratio or particle size multiplier. This involves calculating the $PM_{2.5}$ emissions from the PM_{10} emissions using the ratio of $PM_{2.5}$ to PM_{10} emission factors in AP-42.

However, the use of state, local, and tribal emission factors are preferred over any other approach because they are always specific.

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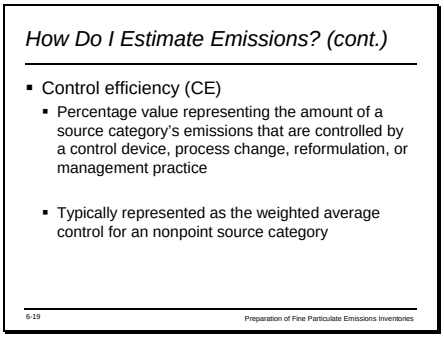

Control efficiency is the percentage value representing the amount of a source category's emissions that is controlled by a control device, process change, reformulation, or a management practice.

Typically, the value is represented as the weighted average control for a nonpoint source category.

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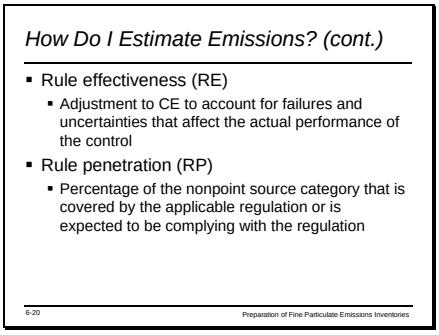

Rule effectiveness is an adjustment to the control efficiency to account for failures and uncertainties that affect the actual performance of the control method.

Rule penetration represents either the percentage of the nonpoint source category that is covered by the applicable regulation, or that which is expected to be in compliance with the regulation.

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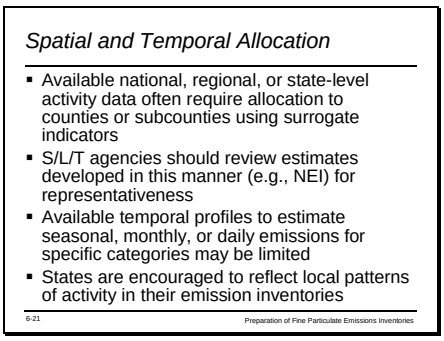

The available national, regional, or state-level activity data often require allocation to counties or subcounties using surrogate indicators.

State, local, and tribal agencies should review emission estimates developed in this manner for representativeness.

The available temporal profiles to estimate seasonal, monthly, or daily emissions for specific categories may be limited, so states are encouraged to reflect local patterns of activity in their emission inventories.

For example, residential home heating emissions from fuel oil combustion can be allocated to the county level by using the number of households in each county in the state.

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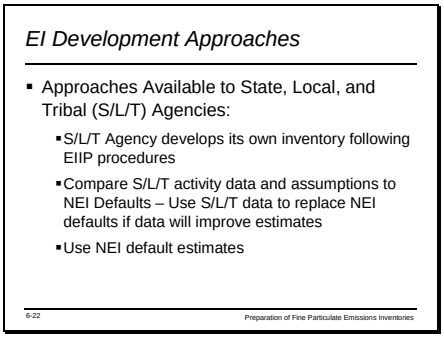

The approaches that are available to state, local, and tribal agencies for developing an emissions inventory include:

- develop an emissions inventory following the EIIP procedures
- compare the state, local, tribal activity data and assumptions to the NEI defaults and replacing the defaults, as necessary
- use the NEI default estimates

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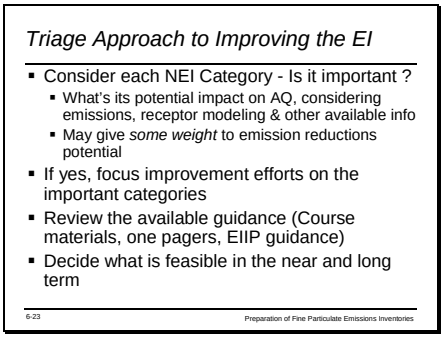

The triage approach to improving the emissions inventory involves:

- considering the importance of each NEI category
- examining the potential impact on air quality
- considering emissions, receptor modeling, and other available information

Improvements should be made to those categories that are determined to be important using the suggestions and references provided in this training course. This includes reviewing the available guidance and deciding on feasible approaches.

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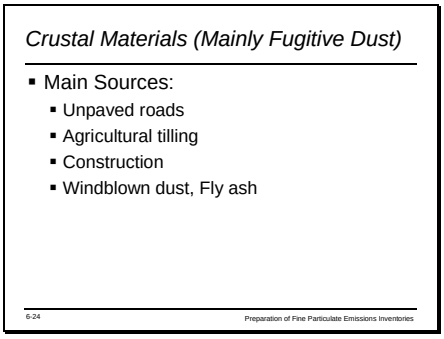

The main sources of crustal materials are unpaved roads, agricultural tilling, construction, and wind-blown dust.

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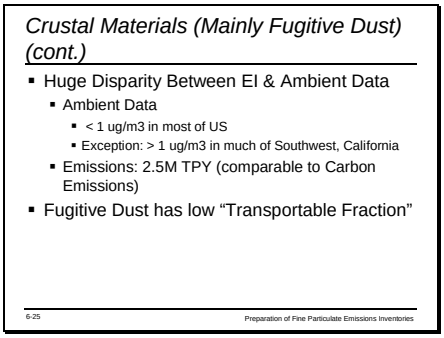
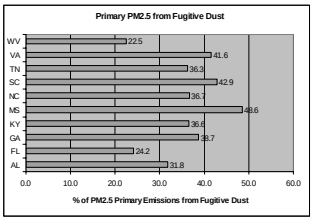


There is a huge disparity between the crustal data in an emissions inventory and the ambient air quality data.

The amount of crustal material on the ambient filters is less than expected, given the large estimates of fugitive dust emissions in the NEI. The reason for this apparent anomaly is that fugitive dust has a low transportable fraction.

6 - 26

Fugitive Dust Emissions in VISTAS States



6-26

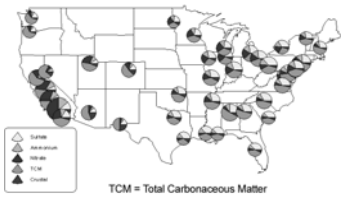
Preparation of Fine Particulate Emissions Inventories

The data on this graph shows that $PM_{2.5}$ inventories in the states included in the VISTAS area have fugitive dust in the 20-40% range.

The rest of PM in the inventory is from sources that are primarily carbonaceous.

6 - 27

Urban (EPA STN) Annual Averages Sep 2001-Aug 2002

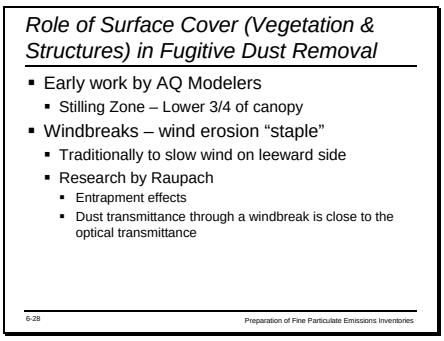


6-27

Preparation of Fine Particulate Emissions Inventories

Comparing the data in the previous slide with the data presented in this figure shows that the ratio of crustal $PM_{2.5}$ emissions to total carbonaceous matter emissions does not match the ratio of crustal to total carbonaceous $PM_{2.5}$ based on the ambient data.

6 - 28



In the process of developing models, the stilling zone under the canopy of vegetation was recognized.

The air in this zone (the bottom three-fourths of the height of the vegetation) is still. This promotes gravitational settling and impaction and filtration by the vegetation.

In the western states it is common to see wind breaks. These are rows of trees or other tall vegetation designed to slow the wind speed on the leeward side.

The objective is to prevent the wind from picking up the soil and causing erosion.

Another important feature of windbreaks is the entrapment effect involving the transmittance of dust through a wind break. Research shows that the dust that goes through a wind break is similar to the optical transmittance of light through a wind break. The remainder is trapped in the windbreak.

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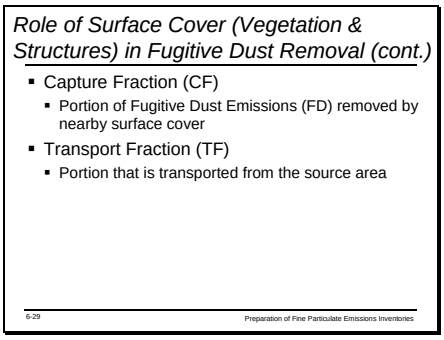


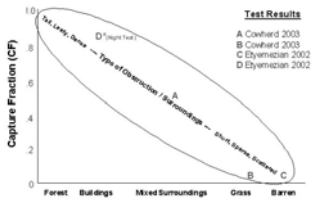
Capture fraction is the portion of fugitive dust emissions that are removed by nearby surface cover.

Transport fraction is the portion that is transported out of the source area.

Adding the two sums produces the fugitive dust emissions inventory.

6 - 30

Capture Fraction ~ Conceptual Model and Field Measurement Results



6-30 Preparation of Fine Particulate Emissions Inventories

This graph plots a capture fraction value and the type of vegetation qualitatively described as going from densely forested to barren.

The test data plotted on this graph suggest a relationship between the amount of vegetation and the capture fraction.

Specifically, the data suggest that tall leafy dense vegetation has a high capture fraction and the short sparse scattered vegetation has a low capture fraction.

6 - 31

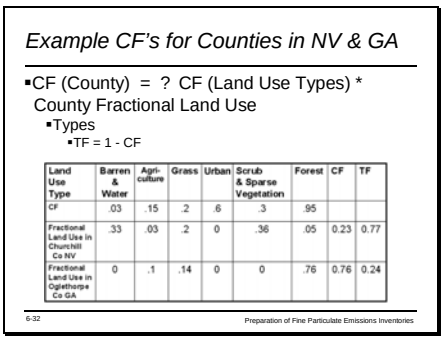
Estimates of CF for Specific Surface Conditions

Surface Cover Type	CF (Estimated)
Smooth, Barren or Water	0.03 – 0.1
Agricultural	0.1 - 0.2
Grasses	0.2 - 0.3
Scrub and Sparsely Wooded	0.3 - 0.5
Urban	0.6 - 0.7
Forested	0.9 - 1.0

6-31 Preparation of Fine Particulate Emissions Inventories

The conceptual model suggested by the data in the previous graph has yet to be integrated with air quality models, but it does allow for the assignment of capture fractions to the variety of vegetation shown here.

6 - 32



By using land use databases that contain data on fractional land use in six different areas (barren and water, agriculture, grass, urban, scrub and sparse vegetation, and forest) it is possible to compute the capture fraction.

As shown in this table, the capture fraction for a given area is the sum of capture fraction by land use type times the county fractional land use amount. The transport fraction is equal to one minus the capture fraction.

For example, the transport fraction from the source in Churchill County, Nevada is much higher than the amount that gets away from the source in Oglethorpe County, Georgia. The main difference is the amount of trees in those two areas. In general, the transport fraction is fairly low in those areas of the country that are very heavily forested, or in cities with a lot of buildings.

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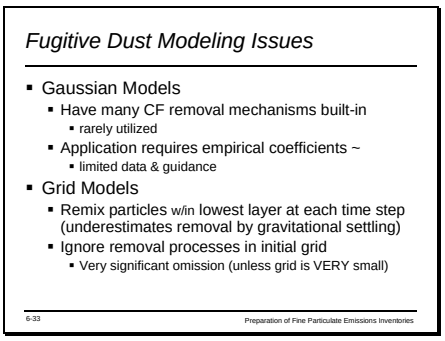


There are modeling issues associated with using this approach to account for different transport characteristics of dust in different parts of the country.

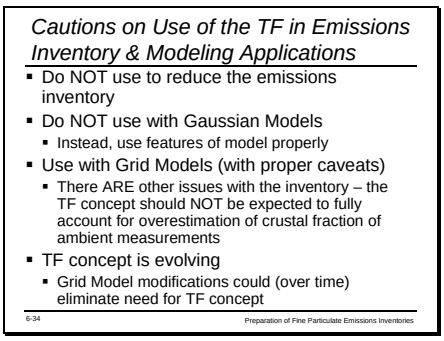
Gaussian models actually have removal mechanisms built in to them to accommodate capture fraction through the use of empirical coefficients. Unfortunately, there is limited data and guidance on how to apply these coefficients, so they are rarely used.

Grid models on the other hand are not equipped to handle particle transport. They tend to remix particles within the lowest layer during each time step, resulting in an underestimation of gravitational settling removal.

Within a time step of the model particles have had a chance to settle down, but not settle out. In the next time step they are remixed into the whole lower mixing cell, so they may never get out.

Also, in the initial grid removal processes, even gravitational settling is ignored. This is a very significant omission unless the grid is very small. However, modeling very small grids is not really practical.

6 - 34

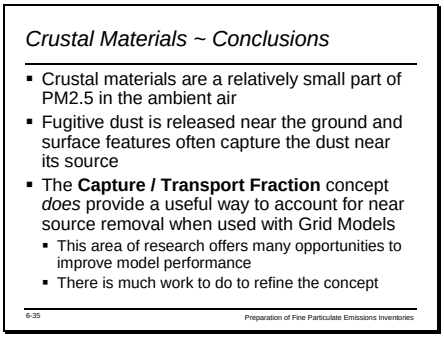


Transport fractions should not be used to reduce the emission inventory, nor should they be used with Gaussian models.

They can be used with grid models with the proper caveats. Because there are other issues with the inventory, there will not be instantaneous agreement between the fugitive dust emissions and the ambient data.

For example, there are issues with applying the unpaved road factors properly. The transport fraction concept is evolving and over time grid model modifications could eliminate the need for this approach.

6 - 35



Crustal material is a relatively small part of $PM_{2.5}$ in the ambient air.

Fugitive dust is released near the ground and surface features often capture the dust near its source.

Finally, the capture/transport fraction concept provides a useful way to account for near source removal when used with grid models. This area of research offers many opportunities to improve model performance.